PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-013239

(43)Date of publication of application : 19.01.2001

(51)Int.Cl. G01S 7/521
H04R 17/00

(21)Application number : 11-186941

(22)Date of filing : 30.06.1999

(71)Applicant : MATSUSHITA ELECTRIC WORKS LTD

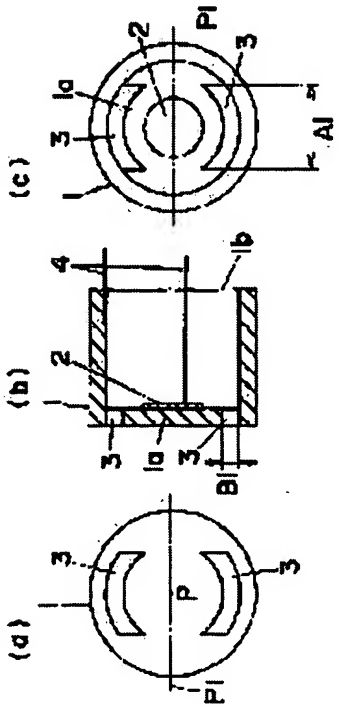
(72)Inventor : KAJIYAMA TOMOHITO
SHIBATA KIWAMU
TAKAGI TOSHIMASA
UNO MASATAKE
ONO TAKESHI
HASHIMOTO YUSUKE
OOTANI RIYUUJI
ADACHI MASAHIKO

(54) ULTRASONICVIBRATOR

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain an ultrasonic vibrator that allows the thickness of beams in each direction to differ without using any horns.

SOLUTION: In a cylindrical case 1 in nearly a cylindrical shape, its one end face 1b is open, a piezoelectric element 2 is applied to nearly the central part inside the cylindrical case 1 on the other end face for arrangement as a vibration surface 1a, and ultrasonic waves are transmitted and received from the vibration surface 1a. On the vibration surface 1a, circular arc-shaped openings 3 and 3 with a length A1 in parallel with each one center line P1 and with a length B1 in a direction that orthogonally crosses the direction of the length A1 are provided at a position that is located outside the position where the piezoelectric element 2 is provided and is symmetrical with the center line P1 passing through a center P of the vibration surface 1a as a center.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-013239

(43)Date of publication of application : 19.01.2001

(51)Int.Cl. G01S 7/521

H04R 17/00

(21)Application number : 11-186941

(22)Date of filing : 30.06.1999

(71)Applicant : MATSUSHITA ELECTRIC WORKS LTD

(72)Inventor : KAJIYAMA TOMOHITO
SHIBATA KIWAMU
TAKAGI TOSHIMASA
UNO MASATAKE
ONO TAKESHI
HASHIMOTO YUSUKE
OOTANI RIYUUJI
ADACHI MASAHIKO

(54) ULTRASONICVIBRATOR

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain an ultrasonic vibrator that allows the thickness of beams in each direction to differ without using any horns.

SOLUTION: In a cylindrical case 1 in nearly a cylindrical shape, its one end face 1b is open, a piezoelectric element 2 is applied to nearly the central part inside

the cylindrical case 1 on the other end face for arrangement as a vibration surface 1a, and ultrasonic waves are transmitted and received from the vibration surface 1a. On the vibration surface 1a, circular arc-shaped openings 3 and 3 with a length A1 in parallel with each one center line P1 and with a length B1 in a direction that orthogonally crosses the direction of the length A1 are provided at a position that is located outside the position where the piezoelectric element 2 is provided and is symmetrical with the center line P1 passing through a center P of the vibration surface 1a as a center.

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

CLAIMS

[Claim(s)]

[Claim 1] It is the ultrasonic vibrator characterized by to have opening in the location which becomes symmetrical as a core about the center line passing through each core of a field that the shaft and said tubed case cross at right angles in the ultrasonic vibrator which an end side carries out opening, and prepares a piezoelectric device in the tubed case inside abbreviation center section, makes the other end side of the tubed case where the other end side was blockaded a plane of vibration, and performs wave transmission and wave-receiving of a supersonic wave.

[Claim 2] Said opening is an ultrasonic vibrator according to claim 1 characterized by being formed in said plane of vibration.

[Claim 3] Said opening is an ultrasonic vibrator according to claim 1 characterized by being formed in the side face of said tubed case.

[Claim 4] Said opening is an ultrasonic vibrator according to claim 1 characterized by being applied and formed in the side face of said tubed case from said plane of vibration.

[Claim 5] An ultrasonic vibrator given in either of claim 1 to claims 4 characterized by changing said center line and parallel lay length of said opening, and adjusting the directional characteristics of a supersonic wave.

[Claim 6] An ultrasonic vibrator given in either of claim 1 to claims 4 characterized by changing the lay length which intersects perpendicularly with

said center line of said opening, and adjusting the directional characteristics of a supersonic wave.

[Claim 7] It is the ultrasonic vibrator which an end side carries out opening, and prepares a piezoelectric device in the tubed case inside abbreviation center section, makes the other end side of the tubed case where the other end side was blockaded a plane of vibration, and is characterized by said plane of vibration having a thin-walled part with thin thickness in the location which becomes symmetrical centering on the center line passing through the core in the ultrasonic vibrator which performs wave transmission and wave-receiving of a supersonic wave.

[Claim 8] the configuration inside [said / tubed case] said plane of vibration is prolonged in the formation direction in which said thin-walled part is formed to the center line of said plane of vibration -- mutual -- abbreviation -- the ultrasonic vibrator according to claim 7 characterized by being the configuration which has two parallel straight lines.

[Claim 9] The ultrasonic vibrator according to claim 8 characterized by being said more than parallel lay length of said plane of vibration which has said center line and parallel lay length of said thin-walled part between each thin-walled part prepared in said location which becomes symmetrical.

[Claim 10] Said thin-walled part is an ultrasonic vibrator according to claim 7 characterized by being the configuration to which width of face becomes narrow toward the depth direction.

[Claim 11] Said thin-walled part is an ultrasonic vibrator given in either of claim 7 to claims 10 characterized by being prepared inside said tubed case of said plane of vibration.

[Claim 12] Said thin-walled part is an ultrasonic vibrator given in either of claim 7 to claims 10 characterized by being prepared in the outside of said tubed case of said plane of vibration.

[Claim 13] Said thin-walled part is an ultrasonic vibrator given in either of claim 7 to claims 10 characterized by being prepared in both the inside of said tubed

case of said plane of vibration, and the inside.

[Claim 14] the configuration of said tubed case outside of said plane of vibration is prolonged in the formation direction in which said thin-walled part is formed to the center line of said plane of vibration -- mutual -- abbreviation -- the ultrasonic vibrator according to claim 7 characterized by being the configuration which has two parallel straight lines.

[Claim 15] An ultrasonic vibrator given in either of claim 1 to claims 14 characterized by manufacturing said tubed case by the forging process.

[Claim 16] An ultrasonic vibrator given in either of claim 1 to claims 15 characterized by preparing the level difference section in the side face of said tubed case so that the direction of said end side side which carried out opening may become [the thickness of the outer wall of said tubed case side face] thicker than said plane-of-vibration side.

[Claim 17] Said level difference section is an ultrasonic vibrator given in either of claim 1 to claims 16 characterized by being a taper configuration.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the ultrasonic vibrator of the ultrasonic sensor which receives the reflected wave from an obstruction and detects existence of an obstruction while transmitting an ultrasonic signal.

[0002]

[Description of the Prior Art] As an ultrasonic sensor which performs the conventional obstruction detection, from an ultrasonic sensor, an ultrasonic pulse is sent into air, is reflected in obstructions, such as a detection object object, an ultrasonic sensor receives the reflected wave, the input signal is processed, and it has composition which emits an alarm etc. The ultrasonic vibrator which has sent and received the supersonic wave of the above-mentioned ultrasonic sensor is a configuration as shown in the front view of drawing 14 (a), and the side-face sectional view of drawing 14 (b). The piezoelectric device 52 stuck on the tubed case 51 inside with adhesives is formed, and the field by the side of the tubed case 51 other end of the hollow in which the end side carried out opening has become plane-of-vibration 51a, and transmits and receives an ultrasonic signal. Acoustic material 53 is arranged at the side stuck on the above-mentioned plane-of-vibration 51a of a piezoelectric device 52. The lead wire 54 connected to the piezoelectric device 52 and the tubed case 51 and the shielding wire 56 which transmits the signal outputted and inputted from the control circuit side which is not illustrated are connected with the terminal substrate 55. Moreover, the interior of this tubed case 51 is filled up with the filler 57.

[0003] however -- this ultrasonic vibrator -- plane-of-vibration 51a -- circular -- since thickness is fixed -- the ultrasonic vibrator itself -- in view of an ultrasonic vibrator -- all the directions -- abbreviation -- it becomes uniform directivity. Although the ultrasonic vibrator of the obstruction detection for cars is attached in the bumper of a car etc., detection area of the longitudinal direction of the ultrasonic vibrator when attaching in a car is made large in order to detect existence of an obstruction, and it is necessary to narrow detection area of a

lengthwise direction in order to prevent detection of the unnecessary body on a road surface. Therefore, it is as perpendicular as a horizontal direction and the directivity from which the size of the beam of the supersonic wave of an ultrasonic vibrator differs is needed. Therefore, in the conventional ultrasonic vibrator, the horn 58 needed to be formed through maintenance rubber 59, and beam control of a supersonic wave needed to be performed. The horn 58 is performing beam control from the opening 60 which has diameter-medianus 58a, transverse-diameter 58b, and depth 58c, as shown in drawing 15 (a) and (b).
[0004]
[Problem(s) to be Solved by the Invention] In the ultrasonic vibrator which has such a horn 58, during car transit etc., storm sewage may enter, or the interior of a horn 58 may tend to be covered with snow, dust, etc., the beam of a supersonic wave may change by that cause, and the detection area of the object of an obstruction etc. may change. Moreover, although the thing included in the horn 58 interior was detected and there was no detection object object in detection area, there was a problem which incorrect-detects it. And since the hole of a projection and horn 58 the very thing existed [a horn 58] from a bumper side again in order to attach an ultrasonic vibrator in a bumper etc., there was a problem that an exterior was not good, either. Thus, in order to make the size of the beam of an ultrasonic vibrator differ, the problem described above when the horn was used occurred.
[0005] In view of the above-mentioned reason, it succeeds in this invention, and is in the purpose offering the ultrasonic vibrator which can differ the directional characteristics of the beam of a supersonic wave, without using a horn.
[0006]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, invention of claim 1 In the ultrasonic vibrator which an end side carries out opening, and prepares a piezoelectric device in the tubed case inside abbreviation center section, makes the other end side of the tubed case where the other end side was blockaded a plane of vibration, and performs wave

transmission and wave-receiving of a supersonic wave Said tubed case is characterized by having opening in the location which becomes symmetrical as a core about the center line passing through each core of the field which intersects perpendicularly with the shaft. Therefore, since vibration of the direction which intersects perpendicularly with the center line of a plane of vibration has opening in the both ends, it vibrates so that the part which carries out flat-surface vibration may become large in the direction which rigidity becomes weak, becomes easy to vibrate and intersects perpendicularly with a plane of vibration compared with a center line and a parallel vibration. Consequently, it becomes possible to compare horizontally, to make a vertical beam sharp and to make objective detection area small, and an ultrasonic vibrator can form directional characteristics with different directivity.

[0007] Moreover, invention of claim 2 is characterized by forming said opening in said plane of vibration in invention according to claim 1. Therefore, the same effectiveness as claim 1 is acquired.

[0008] Moreover, it is characterized by for invention according to claim 1 setting invention of claim 3, and forming said opening in the side face of said tubed case. Therefore, while the same effectiveness as claim 1 is acquired, in order not to prepare opening in a plane of vibration, it can arrange, without restricting the magnitude and the location of a piezoelectric device, and an appearance also becomes good.

[0009] Moreover, invention of claim 4 is characterized by being formed in the side face of said tubed case from said plane of vibration, applying said opening in invention according to claim 1. Therefore, large opening can be taken, and in performing wave transmission of a supersonic wave, and wave-receiving, since the rigidity of the formation direction which formed opening to the center line of a plane of vibration can be weakened, the different directivity of the directional characteristics of a beam can be improved.

[0010] Moreover, invention of claim 5 is characterized by changing said center line and parallel lay length of said opening, and adjusting the directional

characteristics of a supersonic wave in invention given in either of claim 1 to claims 4. Therefore, the directional characteristics of a supersonic wave can be changed.

[0011] Moreover, invention of claim 6 is characterized by changing the lay length which intersects perpendicularly with said center line of said opening, and adjusting the directional characteristics of a supersonic wave in invention given in either of claim 1 to claims 4. Therefore, the directional characteristics of a supersonic wave can be changed.

[0012] Moreover, an end side carries out opening of the invention of claim 7, a piezoelectric device is prepared in the tubed case inside abbreviation center section, the other end side of the tubed case where the other end side was blockaded is made into a plane of vibration, and said plane of vibration is characterized by having a thin-walled part with thin thickness in the location which becomes symmetrical centering on the center line passing through the core in the ultrasonic vibrator which performs wave transmission and wave-receiving of a supersonic wave. Therefore, since vibration of the direction which intersects perpendicularly with the center line of a plane of vibration has a thin-walled part in the both ends, it vibrates so that the part which carries out flat-surface vibration may become large in the direction which rigidity becomes weak, becomes easy to vibrate and intersects perpendicularly with a plane of vibration compared with a center line and a parallel vibration. Consequently, it becomes possible to compare horizontally, to make a vertical beam sharp and to make objective detection area small, and an ultrasonic vibrator can form directional characteristics with different directivity.

[0013] in invention according to claim 7, as for invention of claim 8, the configuration inside [said / tubed case] said plane of vibration is prolonged by said thin-walled part in the formation direction currently formed to the center line of said plane of vibration -- mutual -- abbreviation -- it is characterized by being the configuration which has two parallel straight lines. Therefore, a center line and the beam of a horizontal supersonic wave can be made thick, and the

different directivity of the directional characteristics of the beam of a supersonic wave can be improved.

[0014] Moreover, invention of claim 9 is characterized by being said more than parallel lay length of said plane of vibration which has said center line and parallel lay length of said thin-walled part between each thin-walled part prepared in said location which becomes symmetrical in invention according to claim 8. Therefore, a center line and the beam of a vertical supersonic wave can be made thick, and the different directivity of the directional characteristics of the beam of a supersonic wave can be improved.

[0015] Moreover, invention of claim 10 is characterized by said thin-walled part being a configuration to which width of face becomes narrow toward the depth direction in invention according to claim 7. Therefore, in manufacture of a tubed case, a thin-walled part can be easily formed with a sufficient precision in plastic working.

[0016] Moreover, invention of claim 11 is characterized by preparing said thin-walled part inside said tubed case of said plane of vibration in invention given in either of claim 7 to claims 10. Therefore, the appearance of a tubed case becomes good.

[0017] Moreover, invention of claim 12 is characterized by preparing said thin-walled part in the outside of said tubed case of said plane of vibration in invention given in either of claim 7 to claims 10. Therefore, after filling up the interior of a tubed case with a filler, the die length of a thin-walled part, the depth, and a number can adjust the vibrational state of a plane of vibration to arbitration.

[0018] Moreover, invention of claim 13 is characterized by preparing said thin-walled part in both the inside of said tubed case of said plane of vibration, and the inside in invention given in either of claim 7 to claims 10. Therefore, the vibrational state which serves as a target of a plane of vibration by the thin-walled part prepared inside can be formed, the vibrational state after manufacture of an ultrasonic vibrator can be finely tuned by the outside thin-walled part, since an outside thin-walled part is formed for fine tuning, the magnitude can be made

small and an appearance becomes good.

[0019] moreover, in invention according to claim 7, as for invention of claim 14, the configuration of said tubed case outside of said plane of vibration is prolonged by said thin-walled part in the formation direction currently formed to the center line of said plane of vibration -- mutual -- abbreviation -- it is characterized by being the configuration which has two parallel straight lines. Therefore, since thickness of the maintenance rubber holding a tubed case can be enlarged in case the center line of said tubed case and parallel width of face become narrow and an ultrasonic vibrator is attached in the bumper of a car, the effect on [from the bumper installation section] a plane of vibration is mitigable. Moreover, the formation direction of a thin-walled part can be known from the appearance of a tubed case.

[0020] Moreover, invention of claim 15 is characterized by manufacturing said tubed case by the forging process in invention given in either of claim 1 to claims 14. Therefore, the manufacturing cost of a tubed case is reducible.

[0021] Moreover, in invention given in either of claim 1 to claims 15, invention of claim 16 is characterized by preparing the level difference section in the side face of said tubed case so that the direction of said end side side which carried out opening may become [the thickness of the outer wall of said tubed case side face] thicker than said plane-of-vibration side. Therefore, while being able to make small the appearance when attaching an ultrasonic vibrator in the bumper of a car, the rigidity of a tubed case can vibrate strength and a plane of vibration more greatly with the outer wall with which the thickness by the side of the end side which carried out opening became thick.

[0022] Moreover, invention of claim 17 is characterized by said level difference section being a taper configuration in invention given in either of claim 1 to claims 16. Therefore, manufacture by forging of a tubed case is attained and a manufacturing cost can be reduced.

[0023]

[Embodiment of the Invention] (Operation gestalt 1) Drawing 1 is drawing

showing the operation gestalt 1 of the ultrasonic vibrator of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view. The end side 1c is carrying out opening of the approximately cylindrical tubed case 1, it is blockaded, an other end side sticks and arranges a piezoelectric device 2 in the abbreviation center section of the tubed case 1 inside, and it is setting it to plane-of-vibration 1a. While the lead wire 4 with which a signal is outputted and inputted from an external circuit is connected with the tubed case 1 at each of a piezoelectric device 2, vibrating a piezoelectric device 2 based on the inputted signal and transmitting a supersonic wave to top [a / plane-of-vibration 1] Norikazu end-face 1b and the opposite side The supersonic wave which transmitted waves receives the reflected wave reflected in the body from plane-of-vibration 1a, and outputs an electrical signal to the above-mentioned external circuit from lead wire 4 through a piezoelectric device 2. That is, an ultrasonic vibrator is constituted by the tubed case 1, a piezoelectric device 2, and lead wire 4.

[0024] It is the outside of the location in which the piezoelectric device 2 was formed, and it has every one die length A1 in parallel with a center line P1, respectively in the location which becomes symmetrical centering on the center line P1 passing through the core P of plane-of-vibration 1a, and openings 3 and 3 of the shape of radii which has die length B1 are formed in die-length A1 direction and the direction which intersects perpendicularly on the field of plane-of-vibration 1a which is one of the fields which intersect perpendicularly with the shaft of the tubed case 1. The closure of these openings 3 and 3 is carried out with rubber.

[0025] since vibration of the direction (it calls perpendicularly henceforth) which intersects perpendicularly with the center line P1 of this ultrasonic vibrator has openings 3 and 3 in those both ends -- rigidity -- weak -- becoming -- vibrating -- being easy -- it vibrates so that the part which carries out flat-surface vibration may become large in the direction which intersects perpendicularly with plane-of-vibration 1a compared with vibration of a center line P1 and a parallel direction (it

calls horizontally henceforth). Consequently, it becomes possible to compare horizontally, to make a vertical beam sharp and to make objective detection area small, and an ultrasonic vibrator can form directional characteristics with different directivity.

[0026] Moreover, since the rigidity of the perpendicular direction of plane-of-vibration 1a changes by changing the center line P1 of opening 3, the parallel lay length A1, or the lay length B1 that intersects perpendicularly with a center line P1, the vibrational state of the perpendicular direction of plane-of-vibration 1a changes. Therefore, by changing the above-mentioned die length A1 or die length B1, a setup becomes possible freely about the sharpness of the beam of the perpendicular direction of plane-of-vibration 1a, and the directional characteristics of a supersonic wave can be adjusted.

(Operation gestalt 2) Drawing 2 is drawing showing the operation gestalt 2 of the ultrasonic vibrator of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view. As opposed to openings 3 and 3 having been formed in the location where a different point from drawing 1 in drawing 2 becomes symmetrical as a core about a center line P1 in drawing 1 at a plane-of-vibration 1a top, respectively In drawing 2 , it is the point that the openings 3a and 3a of the shape of an abbreviation rectangle which has every one die length A2 in parallel with a center line P1, respectively, and has die-length B-2 in the direction which intersects perpendicularly with die length A2 are formed in the location which touches plane-of-vibration 1a of side-face 1c of the tubed case 1. Here, a center line P1 is a center line passing through the field which has the openings 3a and 3a of the side face of the tubed case 1, i.e., the field which intersects perpendicularly with the shaft of the tubed case 1.

[0027] Since opening 3a is prepared, vibration of the perpendicular direction of plane-of-vibration 1a vibrates so that the part which carries out flat-surface vibration may become large in the direction which rigidity becomes weak, becomes easy to vibrate and intersects perpendicularly with plane-of-vibration 1a compared with a horizontal vibration. Consequently, it becomes possible to

compare horizontally, to make a vertical beam sharp and to make objective detection area small, and an ultrasonic vibrator can form directional characteristics with different directivity.

[0028] Moreover, by changing lay length B-2 which intersects perpendicularly with the center line P1 of opening 3a, the parallel lay length A2, or a center line P1 like drawing 1 , a setup becomes possible freely about the sharpness of the beam of the perpendicular direction of plane-of-vibration 1a, and the directional characteristics of a supersonic wave can be adjusted.

[0029] And since there is no opening in plane-of-vibration 1a, it can arrange, without restricting the magnitude and the attachment location of a piezoelectric device 2, and an appearance also becomes good again.

(Operation gestalt 3) Drawing 3 is drawing showing the operation gestalt 3 of the ultrasonic vibrator of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view. It is the point prepared one [at a time] in the location where opening which carried out opening, having applied to side-face connected [it] from edge of plane-of-vibration 1a by drawing 3 to openings 3 and 3 having been formed in location where different point from drawing 1 in drawing 3 becomes symmetrical as core about center line P1 on plane-of-vibration 1a in drawing 1 , respectively 1b 3b becomes symmetrical centering on a center line P1, respectively. And the whole ultrasonic vibrator was covered with maintenance rubber 9, and it has fitted into the bumper of a car. Opening 3b is also closed by this maintenance rubber 9, and it becomes reduction of components mark.

[0030] Thus, since it applied to side-face 1b from plane-of-vibration 1a and opening 3b was prepared, larger opening can be taken, the rigidity of the perpendicular direction of plane-of-vibration 1a can be weakened, it compares horizontally and vibration to which the part which carries out flat-surface vibration becomes large is perpendicularly carried out in the direction which intersects perpendicularly with plane-of-vibration 1a. Consequently, it becomes possible to compare horizontally, to make a vertical beam sharp and to make objective

detection area small, and an ultrasonic vibrator can form directional characteristics with different directivity.

[0031] Moreover, since the rigidity of the perpendicular direction of plane-of-vibration 1a changes by changing the lay length B3 which intersects perpendicularly with the center line P1 direction of opening 3b, parallel lay length A3, or a center line P1, the vibrational state of the perpendicular direction of plane-of-vibration 1a changes. Therefore, a setup becomes possible freely about the sharpness of the beam of the perpendicular direction of plane-of-vibration 1a, and the directional characteristics of a supersonic wave can be adjusted.

(Operation gestalt 4) Drawing 4 is drawing showing the operation gestalt 4 of the ultrasonic vibrator of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view. It is the point that the thin-walled parts 5 and 5 thinner thickly [of plane-of-vibration 1a] one [at a time] are formed in the location which becomes symmetrical as a core about a center line P1 inside the tubed case 1 of plane-of-vibration 1a by drawing 4 to every one openings 3 and 3 having been formed in the location where a different point from drawing 1 in drawing 4 becomes symmetrical as a core about a center line P1 on plane-of-vibration 1a in drawing 1 , respectively, respectively. This thin-walled part 5 is formed in the outside of the location where the piezoelectric device 2 is arranged, and is a radii configuration which has a center line P1, width of face fixed in parallel, and the depth.

[0032] Therefore, although vibration of plane-of-vibration 1a is a horizontally simple flexural oscillation, flexural oscillation arises perpendicularly in the part which is sticking the piezoelectric device 2, and the part which carries out flat-surface vibration becomes large in the direction which becomes easy to vibrate for the thin-walled part 5 prepared in the outside, compares horizontally, and intersects perpendicularly with plane-of-vibration 1a. Consequently, it becomes possible to compare horizontally, to make a vertical beam sharp and to make objective detection area small, and an ultrasonic vibrator can form directional characteristics with different directivity.

(Operation gestalt 5) Drawing 5 is drawing showing the operation gestalt 5 of the ultrasonic vibrator of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view. In drawing 4 , the configuration inside [tubed case 1] plane-of-vibration 1a of a different point from drawing 4 in drawing 5 is an approximate circle configuration. As opposed to the thin-walled part 5 being arranged a little from the periphery of the circle configuration at Core P side In drawing 5 , the configuration inside [tubed case 1] plane-of-vibration 1a is horizontally established for the radii-like curves 7a and 7b on both sides of a center line P1, respectively. It is a point used as the configuration which each edge of the curves 7a and 7b is connected, carries out an abbreviation rectangular cross with a center line P1, and serves as the straight lines 6a and 6b of abbreviation parallel mutually. And it is the location which becomes symmetrical centering on a center line P1, and it has fixed width of face in the location which touches the curves 7a and 7b of the shape of radii of each above, and the circular thin-walled parts 5a and 5a are formed in it in the center line P1 direction.

[0033] For this reason, compared with the case where the configuration inside [tubed case 1] plane-of-vibration 1a is an approximate circle configuration, the width of face of center line P1 direction becomes narrow. Therefore, the horizontal direction of plane-of-vibration 1a vibrates in the narrow range compared with a perpendicular direction, can make a horizontal beam thicker, and becomes possible [making objective detection area small], and an ultrasonic vibrator can form directional characteristics with different directivity.

[0034] At this time, as are shown in drawing 6 (a), and shown in thin-walled part 11of configuration whose core side it is not circular and is straight line parallel to center line P1 in which thin-walled part has fixed width of face a, and drawing 6 (b), outside [both] may be thin-walled part 11c of the configuration which is a straight line parallel to a center line P1 a thin-walled part 11b [of the configuration whose outside is a straight line parallel to a center line P1], and core side.

[0035] Moreover, if it forms so that the thin-walled parts [12a 12b, 12c, and 12d] horizontal die length S1 may become larger than the horizontal width of face S2 in the tubed case 1 inside of plane-of-vibration 1a as shown in drawing 7 (a), (b), (c), and (d) Thin-walled parts [12a, 12b, 12c, and 12d] rigidity can be weakened more, it can compare horizontally, and a vertical beam can be made sharper.
(Operation gestalt 6) Drawing 8 is drawing showing the operation gestalt 6 of the ultrasonic vibrator of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view. As opposed to the thin-walled parts 5 and 5 which have width of face and the depth respectively fixed one [at a time] having been formed in the location where a different point from drawing 4 in drawing 8 becomes symmetrical as a core about a center line P1 inside [tubed case 1] plane-of-vibration 1a in drawing 4 In drawing 8 , it is the point that thin-walled part 5b with the circular configuration where the cross section where width of face becomes small at the location which becomes symmetrical as a core about a center line P1 inside the tubed case 1 of plane-of-vibration 1a as it becomes two at a time deep, respectively is the abbreviation configuration for V characters, and it saw from the tooth back is prepared. Moreover, the cross section where width of face becomes small may be an approximate circle arc configuration as thin-walled part 5b becomes deep.
[0036] Such a cross section can form easily the thin-walled part of the abbreviation configuration for V characters, and an approximate circle arc configuration with a sufficient precision by plastic working. Moreover, the vibrational state of plane-of-vibration 1a can be adjusted by changing the die length of this thin-walled part 5b, the depth, and a number.
(Operation gestalt 7) Drawing 9 is drawing showing the operation gestalt 7 of the ultrasonic vibrator of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view. As opposed to the thin-walled parts 5 and 5 which have width of face and the depth respectively fixed one [at a time] having been formed in the location where a different point from drawing 4 in drawing 9 becomes symmetrical as a core about a center line P1 inside [tubed case 1]

plane-of-vibration 1a in drawing 4 In drawing 9 , it is the point that thin-walled part 5c with the circular configuration where have every two fixed width of face and depth, respectively in the location which becomes symmetrical as a core about a center line P1, and it saw from the transverse plane is prepared in the outside of the tubed case 1 of plane-of-vibration 1a.

[0037] Thus, since thin-walled part 5c is prepared in the outside of the tubed case 1 of plane-of-vibration 1a, also after filling up the interior of the tubed case 1 with a filler, by changing the die length of thin-walled part 5c, the depth, and a number, the vibrational state of plane-of-vibration 1a can be adjusted, and fine tuning after manufacture of an ultrasonic vibrator is attained.

(Operation gestalt 8) Drawing 10 is drawing showing the operation gestalt 8 of the ultrasonic vibrator of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view. As opposed to the thin-walled parts 5 and 5 which have width of face and the depth respectively fixed one [at a time] having been formed in the location where a different point from drawing 4 in drawing 10 becomes symmetrical as a core about a center line P1 inside [tubed case 1] plane-of-vibration 1a in drawing 4 In drawing 10 , it is the point that 5d of thin-walled parts with the circular configuration where have every one fixed width of face and fixed depth, respectively in the location which becomes symmetrical as a core about a center line P1, and it saw from the transverse plane is further prepared also in the outside of the tubed case 1 of plane-of-vibration 1a.

[0038] It is made to tune the oscillation mode after making the vibrational state made into the target of plane-of-vibration 1a and manufacturing an ultrasonic vibrator by formation of the thin-walled part 5 inside the tubed case 1 using 5d of thin-walled parts of the outside of the tubed case 1 here finely.

[0039] While fine tuning of the vibrational state after manufacture of an ultrasonic vibrator is attained by this, the thin-walled part prepared in the outside of the tubed case 1 can be made small, and an appearance becomes good.

[0040] (Operation gestalt 9) Drawing 11 is drawing showing the operation gestalt 9 of the ultrasonic vibrator of this invention, and (a) is [a side-face sectional view

and (c of a front view and (b))] rear view. The outside configuration of the point that the radii-like curves 15a and 15b are perpendicularly formed on both sides of the center line P1, respectively of plane-of-vibration 1a of an ultrasonic vibrator which showed drawing 11 in drawing 5 is the same as that of drawing 5 . Each edge of the curves 15a and 15b is connected, and the points used as the configuration which is prolonged in the direction which carried out the abbreviation rectangular cross with the center line P1, i.e., the direction in which thin-walled part 5a was formed to the center line P1, and in which the straight lines 14a and 14b of abbreviation parallel are formed mutually differ. That is, in the ultrasonic vibrator of drawing 11 , width of face with the outside horizontal configuration is narrow compared with drawing 5 . A perimeter is covered with maintenance rubber 9 and fitting of this ultrasonic vibrator is carried out to a bumper.

[0041] With the configuration of preparing the thin-walled part explained with each above-mentioned operation gestalt, as for side-face vibration of the tubed case 1, it becomes large horizontally. Then, as shown in drawing 11 , it becomes possible to thicken horizontal thickness of maintenance rubber 9 by considering as the outside configuration to which horizontal width of face becomes narrow, and when an ultrasonic vibrator is held with maintenance rubber 9 and attached in a bumper, the effect on plane-of-vibration 1a can be mitigated. Moreover, the outside configuration of plane-of-vibration 1a is not an approximate circle form, and since it is the configuration of having two straight lines of the abbreviation parallel prolonged in the formation direction of thin-walled part 5a to a center line P1, an appearance comes to show the installation direction to a bumper etc.

(Operation gestalt 10) Drawing 12 is the side-face sectional view showing the operation gestalt 10 of the ultrasonic vibrator of this invention. It differs in that the level difference section 17 is formed so that width of face may become [the outer wall 16 in the direction of the end side 1b side which carried out opening to the outer wall of side-face 1c of the tubed case 1 shown in drawing 5 by drawing 12] thick from the outer wall 19 in the direction of the plane-of-vibration 1a side. In

drawing 12 , the ultrasonic vibrator constituted in this way was held with maintenance rubber 9, and it has attached in the bumper 10 so that the level difference section 17 may stop inside a bumper 10.

[0042] With the outer wall 16 constituted so that this width of face might become thick, the rigidity of the tubed case 1 can be strengthened and plane-of-vibration 1a can be vibrated more greatly. At this time, the appearance attached in the bumper 10 can be made small.

[0043] Drawing 13 shows the example which gave the taper 18 to the level difference section 17 shown in drawing 12 . This becomes possible to manufacture the level difference section 17 in forging, and a manufacturing cost can be reduced. Also in what forms thin-walled part 5b in plastic working, and manufactures the tubed case 1 as drawing 8 showed, it manufactures in forging as well as processing of the level difference section 17, and a manufacturing cost can be reduced.

[0044]

[Effect of the Invention] In the ultrasonic vibrator which an end side carries out opening of the invention of claim 1, and prepares a piezoelectric device in the tubed case inside abbreviation center section, makes the other end side of the tubed case where the other end side was blockaded a plane of vibration, and performs wave transmission and wave-receiving of a supersonic wave as described above Since said tubed case has opening in the location which becomes symmetrical as a core about the center line passing through each core of the field which intersects perpendicularly with the shaft, vibration of the direction which intersects perpendicularly with the center line of a plane of vibration Since opening is in the both ends, it vibrates so that the part which carries out flat-surface vibration may become large in the direction which rigidity becomes weak, becomes easy to vibrate and intersects perpendicularly with a plane of vibration compared with a center line and a parallel vibration. Consequently, it becomes possible to compare horizontally, to make a vertical beam sharp and to make objective detection area small, and an ultrasonic

vibrator can form directional characteristics with different directivity.

[0045] Moreover, in invention according to claim 1, since said opening is formed in said plane of vibration, as for invention of claim 2, the same effectiveness as claim 1 is acquired.

[0046] Moreover, it can arrange by invention according to claim 1 setting invention of claim 3, without restricting the magnitude and the location of a piezoelectric device, in order not to prepare opening in a plane of vibration, while the same effectiveness as claim 1 is acquired, since said opening is formed in the side face of said tubed case, and an appearance also becomes good.

[0047] Moreover, in performing wave transmission of a supersonic wave, and wave-receiving, since it is formed in the side face of said tubed case from said plane of vibration, applying said opening and the rigidity of the formation direction which could take large opening and formed opening to the center line of a plane of vibration can be weakened, invention of claim 4 can improve the different directivity of the directional characteristics of a beam in invention according to claim 1.

[0048] Moreover, since invention of claim 5 changes said center line and parallel lay length of said opening and adjusts the directional characteristics of a supersonic wave in invention given in either of claim 1 to claims 4, it can change the directional characteristics of a supersonic wave.

[0049] Moreover, since invention of claim 6 changes the lay length which intersects perpendicularly with said center line of said opening and adjusts the directional characteristics of a supersonic wave in invention given in either of claim 1 to claims 4, it can change the directional characteristics of a supersonic wave.

[0050] Moreover, an end side carries out opening of the invention of claim 7, and prepare a piezoelectric device in the tubed case inside abbreviation center section, make into a plane of vibration the other end side of the tubed case where the other end side was blockaded, and it sets to the ultrasonic vibrator which performs wave transmission and wave-receiving of a supersonic wave.

Since said plane of vibration has a thin-walled part with thin thickness centering on the center line passing through the core in the location which becomes symmetrical, vibration of the direction which intersects perpendicularly with the center line of a plane of vibration Since a thin-walled part is in the both ends, it vibrates so that the part which carries out flat-surface vibration may become large in the direction which rigidity becomes weak, becomes easy to vibrate and intersects perpendicularly with a plane of vibration compared with a center line and a parallel vibration. Consequently, it becomes possible to compare horizontally, to make a vertical beam sharp and to make objective detection area small, and an ultrasonic vibrator can form directional characteristics with different directivity.

[0051] in invention according to claim 7, as for invention of claim 8, the configuration inside [said / tubed case] said plane of vibration is prolonged by said thin-walled part in the formation direction currently formed to the center line of said plane of vibration -- mutual -- abbreviation -- since it is the configuration which has two parallel straight lines, a center line and the beam of a horizontal supersonic wave can be made thick, and the different directivity of the directional characteristics of the beam of a supersonic wave can be improved.

[0052] Moreover, in invention according to claim 8, since invention of claim 9 is said more than parallel lay length of said plane of vibration which has said center line and parallel lay length of said thin-walled part between each thin-walled part prepared in said location which becomes symmetrical, it can make thick a center line and the beam of a vertical supersonic wave, and can improve the different directivity of the directional characteristics of the beam of a supersonic wave.

[0053] Moreover, in invention according to claim 7, since said thin-walled part is a configuration to which width of face becomes narrow toward the depth direction, invention of claim 10 can form a thin-walled part with a sufficient precision easily in plastic working in manufacture of a tubed case.

[0054] Moreover, in invention given in either of claim 7 to claims 10, since said thin-walled part is prepared inside said tubed case of said plane of vibration, as

for invention of claim 11, the appearance of a tubed case becomes good.

[0055] Moreover, in invention given in either of claim 7 to claims 10, since said thin-walled part is prepared in the outside of said tubed case of said plane of vibration, after filling up invention of claim 12 into the interior of a tubed case with a filler, it can adjust the vibrational state of a plane of vibration to arbitration with the die length of a thin-walled part, the depth, and a number.

[0056] Invention of claim 13 is set to invention given in either of claim 7 to claims 10. Moreover, said thin-walled part Since it is prepared in both the inside of said tubed case of said plane of vibration, and the inside, The vibrational state which serves as a target of a plane of vibration by the thin-walled part prepared inside can be formed, the vibrational state after manufacture of an ultrasonic vibrator can be finely tuned by the outside thin-walled part, since an outside thin-walled part is formed for fine tuning, the magnitude can be made small and an appearance becomes good.

[0057] Invention of claim 14 is set to invention according to claim 7. Moreover, the configuration of said tubed case outside of said plane of vibration it extends in the formation direction in which said thin-walled part is formed to the center line of said plane of vibration -- mutual -- abbreviation, since it is the configuration which has two parallel straight lines Since thickness of the maintenance rubber holding a tubed case can be enlarged in case the center line of said tubed case and parallel width of face become narrow and an ultrasonic vibrator is attached in the bumper of a car, the effect on [from the bumper installation section] a plane of vibration is mitigable. Moreover, the formation direction of a thin-walled part can be known from the appearance of a tubed case.

[0058] Moreover, in invention given in either of claim 1 to claims 14, since invention of claim 15 manufactures said tubed case by the forging process, it can reduce the manufacturing cost of a tubed case.

[0059] Moreover, invention of claim 16 is set to invention given in either of claim 1 to claims 15. Since the level difference section is prepared in the side face of said tubed case so that the direction of said end side side which carried out

opening may become [the thickness of the outer wall of said tubed case side face] thicker than said plane-of-vibration side, While being able to make small the appearance when attaching an ultrasonic vibrator in the bumper of a car, the rigidity of a tubed case can vibrate strength and a plane of vibration more greatly with the outer wall with which the thickness by the side of the end side which carried out opening became thick.

[0060] Moreover, in invention given in either of claim 1 to claims 16, since said level difference section is a taper configuration, manufacture of invention of claim 17 by forging of a tubed case is attained, and it can reduce a manufacturing cost.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the structure of the ultrasonic vibrator corresponding to the operation gestalt 1 of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view.

[Drawing 2] It is drawing showing the structure of the ultrasonic vibrator corresponding to the operation gestalt 2 of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view.

[Drawing 3] It is drawing showing the structure of the ultrasonic vibrator corresponding to the operation gestalt 3 of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view.

[Drawing 4] It is drawing showing the structure of the ultrasonic vibrator corresponding to the operation gestalt 4 of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view.

[Drawing 5] It is drawing showing the structure of the ultrasonic vibrator corresponding to the operation gestalt 5 of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view.

[Drawing 6] It is drawing showing other structures of an ultrasonic vibrator same as the above, and each of (a), (b), and (c) is rear view.

[Drawing 7] It is drawing showing the structure of further others of an ultrasonic vibrator same as the above, and each of (a), (b), (c), and (d) is rear view.

[Drawing 8] It is drawing showing the structure of the ultrasonic vibrator corresponding to the operation gestalt 6 of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view.

[Drawing 9] It is drawing showing the structure of the ultrasonic vibrator corresponding to the operation gestalt 7 of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view.

[Drawing 10] It is drawing showing the structure of the ultrasonic vibrator corresponding to the operation gestalt 8 of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view.

[Drawing 11] It is drawing showing the structure of the ultrasonic vibrator corresponding to the operation gestalt 9 of this invention, and (a) is [a side-face sectional view and (c of a front view and (b))] rear view.

[Drawing 12] It is the side-face sectional view showing the condition of having attached the ultrasonic vibrator corresponding to the operation gestalt 10 of this invention in the bumper of a car.

[Drawing 13] It is the side-face sectional view showing other structures of an ultrasonic vibrator same as the above.

[Drawing 14] It is drawing showing the structure of the conventional ultrasonic vibrator, and (a) is a front view and (b) is a side-face sectional view.

[Drawing 15] It is drawing showing the condition of having attached the horn in the conventional ultrasonic vibrator, and (a) is a front view and (b) is a side-face sectional view.

[Description of Notations]

1 Tubed Case

1a Plane of vibration

1b End side

2 Piezoelectric Device

3 Opening

4 Lead Wire

P1 Center line

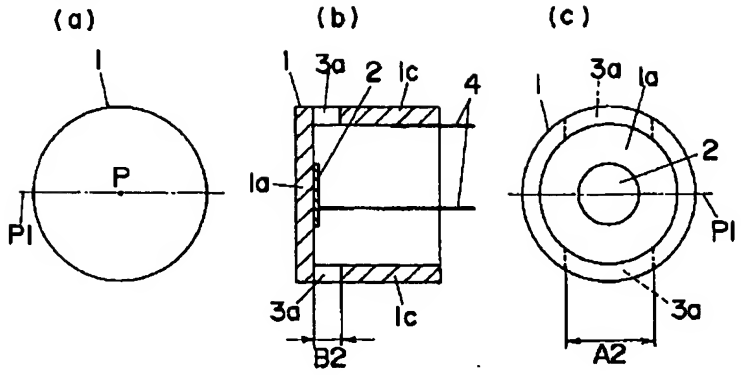
P Core

[Translation done.]

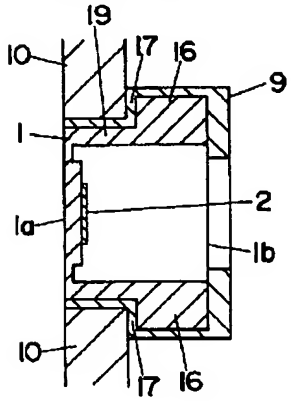
* NOTICES *

DRAWINGS

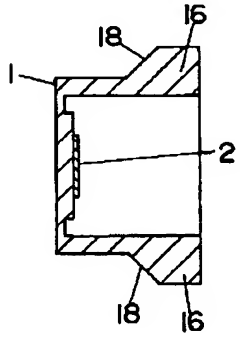
[Drawing 2]



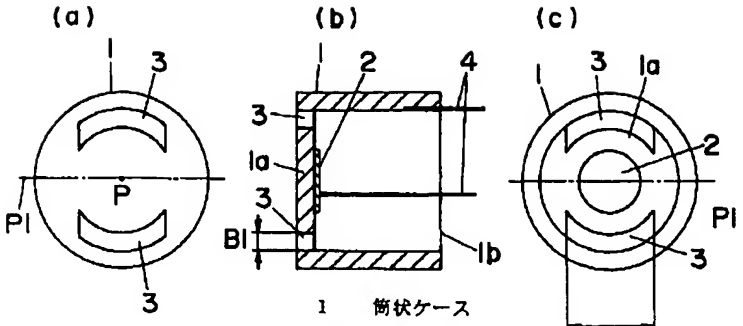
[Drawing 12]



[Drawing 13]

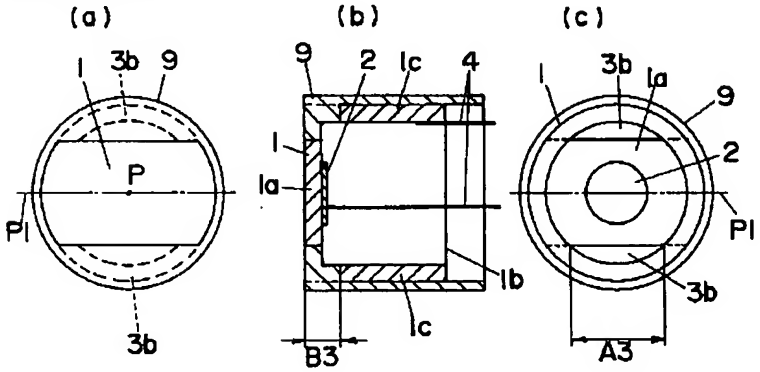


[Drawing 1]

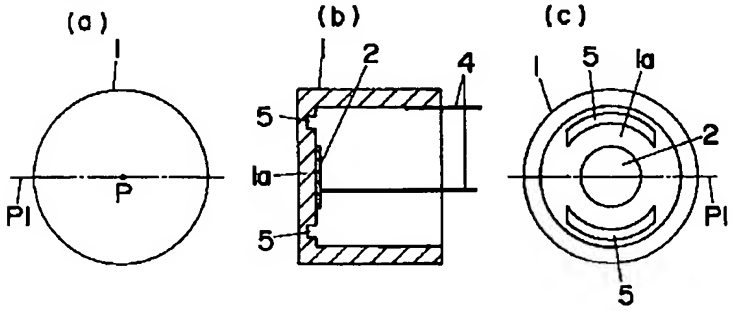


1　筒状ケース
1a　振動面
1b　一端面
2　圧電素子
3　開口部
4　リード線
P1　中心線
P　中心

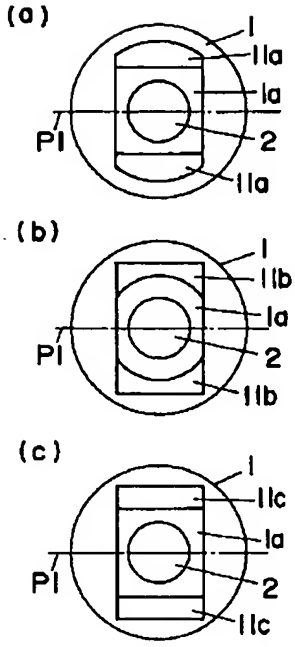
[Drawing 3]



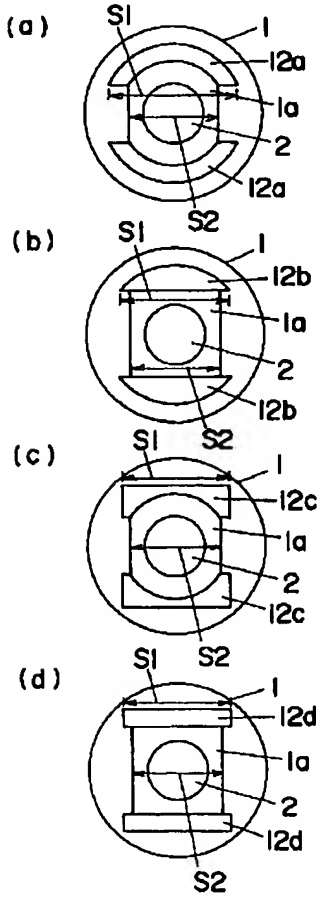
[Drawing 4]



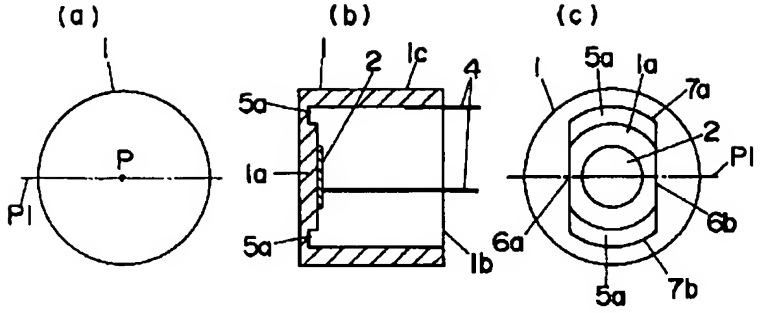
[Drawing 6]


(a)
1
11a
1a
P1
2
11a
(b)
1
11b
1a
P1
2
11b
(c)
1
11c
1a
P1
2
11c

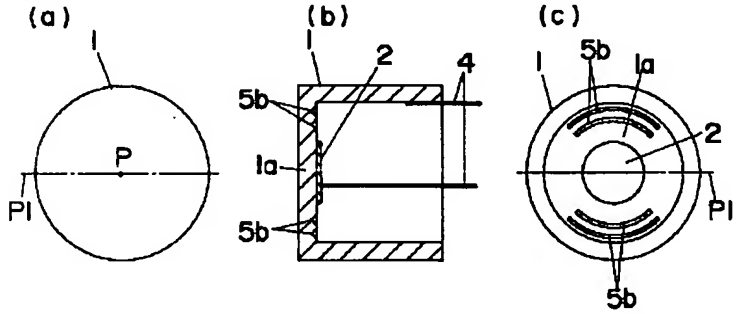
[Drawing 7]


(a)
S1
1
12a
1a
2
12a
S2
(b)
S1
1
12b
1a
2
12b
(c)
S1
S2
1
12c
1a
2
12c
(d)
S1
S2
1
12d
1a
2
12d
S2

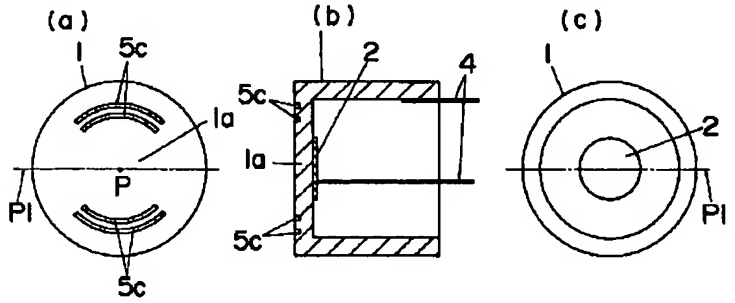
[Drawing 5]



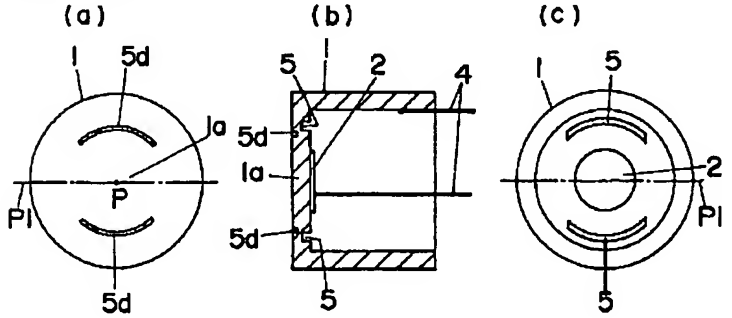
[Drawing 8]



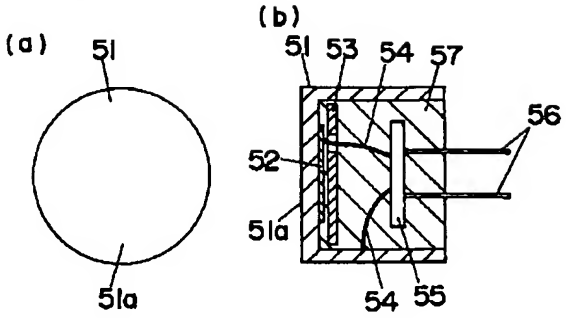
[Drawing 9]



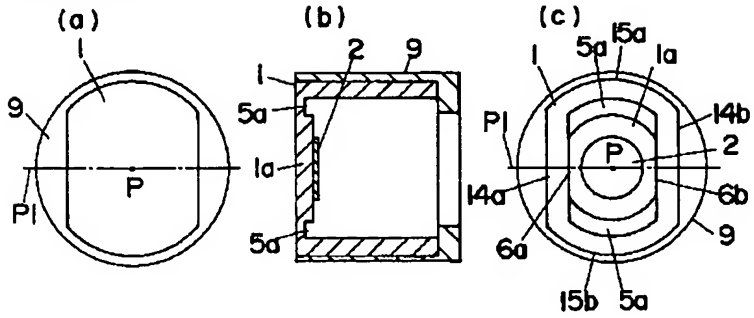
[Drawing 10]



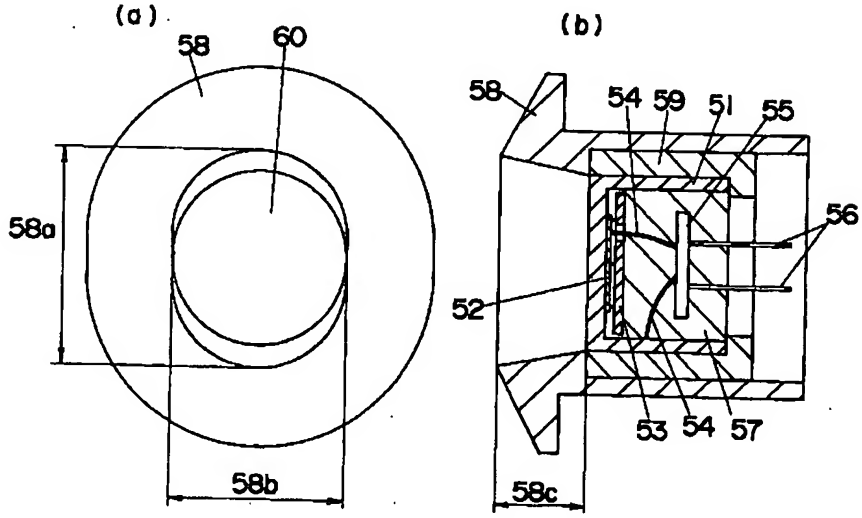
[Drawing 14]



[Drawing 11]



[Drawing 15]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開2001－13239
（P2001－13239A）
(43)公開日　平成13年１月19日(2001.1.19)

(51)Int.Cl.'	識別記号	ＦＩ		テーマコード(参考)
Ｇ０１Ｓ　7/521		Ｇ０１Ｓ　7/52	Ａ	5Ｄ０１９
Ｈ０４Ｒ　17/00	３３０	Ｈ０４Ｒ　17/00	３３０Ｇ	5Ｊ０８３

審査請求　未請求　請求項の数17　ＯＬ　（全 11 頁）

(21)出願番号　特願平11－186941

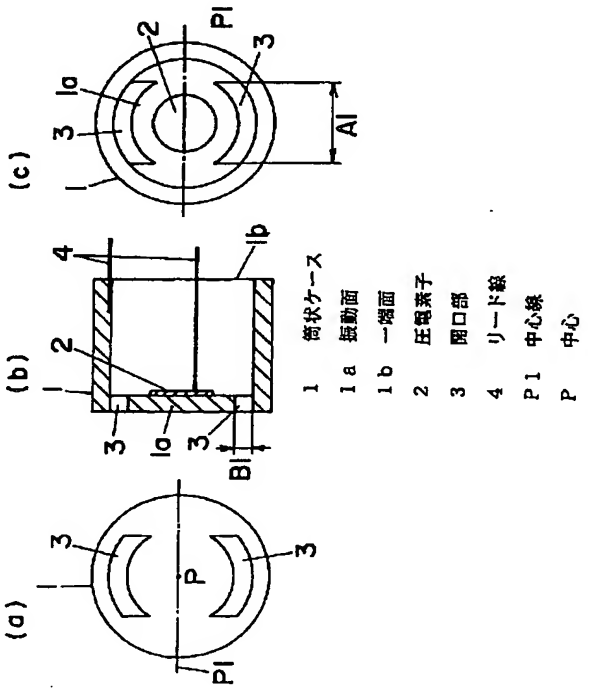
(22)出願日　平成11年６月30日(1999.6.30)

(71)出願人　000005832
松下電工株式会社
大阪府門真市大字門真1048番地
(72)発明者　梶山　智史
大阪府門真市大字門真1048番地松下電工株式会社内
(72)発明者　柴田　究
大阪府門真市大字門真1048番地松下電工株式会社内
(74)代理人　100087767
弁理士　西川　惠清　（外１名）

最終頁に続く

(54)【発明の名称】　超音波振動子

(57)【要約】
【課題】その目的はホーンを用いることなく、各方向のビームの太さを異なるようにできる超音波振動子を提供することにある。
【解決手段】略円筒状の筒状ケース１は、その一端面１ｂが開口しており、他端面の筒状ケース１内側の略中央部に圧電素子２を貼り付けて配置し、振動面１ａとし、この振動面１ａより超音波の送受波が行われる。振動面１ａの面上には、圧電素子２の設けられた位置の外側であり、振動面１ａの中心Ｐを通る中心線Ｐ１を中心に対称となる位置に、それぞれ１つずつ中心線Ｐ１と平行方向に長さＡ１を有し、長さＡ１方向と直交する方向に長さＢ１を有する円弧状の開口部３，３が設けられている。



1

【特許請求の範囲】

【請求項１】　一端面が開口し、他端面が閉塞された筒状ケースの他端面を、その筒状ケース内側略中央部に圧電素子を設けて振動面とし、超音波の送波及び受波を行う超音波振動子において、前記筒状ケースは、その軸と直交する面の各中心を通る中心線を中心として対称となる位置に開口部を有することを特徴とする超音波振動子。

【請求項２】　前記開口部は前記振動面に形成されることを特徴とする請求項１記載の超音波振動子。

【請求項３】　前記開口部は前記筒状ケースの側面に形成されることを特徴とする請求項１記載の超音波振動子。

【請求項４】　前記開口部は前記振動面から前記筒状ケースの側面にかけて形成されることを特徴とする請求項１記載の超音波振動子。

【請求項５】　前記開口部の前記中心線と平行方向の長さを変更して超音波の指向特性を調整することを特徴とする請求項１から請求項４のいずれかに記載の超音波振動子。

【請求項６】　前記開口部の前記中心線と直交する方向の長さを変更して超音波の指向特性を調整することを特徴とする請求項１から請求項４のいずれかに記載の超音波振動子。

【請求項７】　一端面が開口し、他端面が閉塞された筒状ケースの他端面を、その筒状ケース内側略中央部に圧電素子を設けて振動面とし、超音波の送波及び受波を行う超音波振動子において、前記振動面は、その中心を通る中心線を中心に対称となる位置に厚さの薄い薄肉部を有することを特徴とする超音波振動子。

【請求項８】　前記振動面の前記筒状ケース内側の形状は、前記振動面の中心線に対して前記薄肉部が形成されている形成方向に延びる互いに略平行な２つの直線を有する形状であることを特徴とする請求項７記載の超音波振動子。

【請求項９】　前記薄肉部の前記中心線と平行方向の長さが、前記対称となる位置に設けられた各薄肉部間にある前記振動面の前記平行方向の長さ以上であることを特徴とする請求項８記載の超音波振動子。

【請求項１０】　前記薄肉部は、その深さ方向に向かって幅が狭くなる形状であることを特徴とする請求項７記載の超音波振動子。

【請求項１１】　前記薄肉部は、前記振動面の前記筒状ケースの内側に設けられていることを特徴とする請求項７から請求項１０のいずれかに記載の超音波振動子。

【請求項１２】　前記薄肉部は、前記振動面の前記筒状ケースの外側に設けられていることを特徴とする請求項７から請求項１０のいずれかに記載の超音波振動子。

【請求項１３】　前記薄肉部は、前記振動面の前記筒状ケースの内側と内側の両方に設けられていることを特徴

2

とする請求項７から請求項１０のいずれかに記載の超音波振動子。

【請求項１４】　前記振動面の前記筒状ケース外側の形状は、前記振動面の中心線に対して前記薄肉部が形成されている形成方向に延びる互いに略平行な２つの直線を有する形状であることを特徴とする請求項７記載の超音波振動子。

【請求項１５】　前記筒状ケースを鍛造製法により製造することを特徴とする請求項１から請求項１４のいずれかに記載の超音波振動子。

【請求項１６】　前記筒状ケース側面の外壁の肉厚が前記開口した一端面側の方が前記振動面側より厚くなるように、前記筒状ケースの側面に段差部が設けられていることを特徴とする請求項１から請求項１５のいずれかに記載の超音波振動子。

【請求項１７】　前記段差部はテーパ形状であることを特徴とする請求項１から請求項１６のいずれかに記載の超音波振動子。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、超音波信号を送信するとともに障害物からの反射波を受信して障害物の存在を検出する超音波センサの超音波振動子に関するものである。

【０００２】

【従来の技術】従来の障害物検知を行う超音波センサとしては、超音波センサより超音波パルスを空気中に発信し、検知対象物体などの障害物に反射して、その反射波を超音波センサで受信し、その受信信号の処理を行い、警報などを発するような構成になっている。上記超音波センサの超音波を発信および受信している超音波振動子は、図１４（ａ）の正面図、図１４（ｂ）の側面断面図に示すような構成である。一端面が開口した中空の筒状ケース５１他端側の面は、その筒状ケース５１内側に接着剤で貼り合わせた圧電素子５２が設けられて振動面５１ａとなっており、超音波信号の送受信を行う。圧電素子５２の上記振動面５１ａに貼り合わされていない側には、吸音材５３が配置されている。圧電素子５２と筒状ケース５１に接続されたリード線５４と、図示せぬ制御回路側から入出力される信号を伝達するシールド線５６とがターミナル基板５５で接続される。また、この筒状ケース５１の内部には充填材５７が充填されている。

【０００３】しかし、この超音波振動子では振動面５１ａは円形で厚みは一定のため、超音波振動子自体では、超音波振動子からみて全方向に略均一な指向性となる。車両用の障害物検知の超音波振動子は、車両のバンパーなどに取り付けられるが、車両へ取り付けたときの超音波振動子の横方向の検知エリアは、障害物の存在を検知するために広くし、縦方向の検知エリアは路面上の不用物体の検知を防止するため狭くする必要がある。よっ

て、水平方向と垂直方向で超音波振動子の超音波のビームの太さの異なる指向性が必要となる。そのため、従来の超音波振動子では、保持ゴム５９を介してホーン５８を設けて超音波のビーム制御を行う必要があった。ホーン５８は、図１５（ａ）（ｂ）に示すように、縦径５８ａ、横径５８ｂ、深さ５８ｃを有する開口部６０からビーム制御を行っている。

【０００４】

【発明が解決しようとする課題】このようなホーン５８を有する超音波振動子では、車両走行中などに、ホーン５８の内部に雨水が入りこんだり、雪やほこりなどが溜まりやすく、それにより超音波のビームが変化して障害物などの対象物の検知エリアが変わってしまうことがある。また、ホーン５８内部に入ったものを検知してしまい、検知対象物体が検知エリアに無いにもかかわらず、それを誤検知してしまう問題があった。そしてまた、超音波振動子をバンパーなどに取り付けるため、ホーン５８がバンパー面より突出し、またホーン５８自体の穴が存在するため、外観上もよくないという問題があった。このように、超音波振動子のビームの太さを異なるようにするために、ホーンを用いると上記した問題が発生した。

【０００５】本発明は上記事由に鑑みて為されたものであり、その目的はホーンを用いることなく、超音波のビームの指向特性を異なるようにできる超音波振動子を提供することにある。

【０００６】

【課題を解決するための手段】上記課題を解決するために、請求項１の発明は、一端面が開口し、他端面が閉塞された筒状ケースの他端面を、その筒状ケース内側略中央部に圧電素子を設けて振動面とし、超音波の送波及び受波を行う超音波振動子において、前記筒状ケースは、その軸と直交する面の各中心を通る中心線を中心として対称となる位置に開口部を有することを特徴とする。よって、振動面の中心線と直交する方向の振動は、その両端部に開口部があるため剛性が弱くなって振動しやすくなり、中心線と平行方向の振動に比べて、振動面と直交する方向に平面振動する部分が大きくなるように振動する。その結果、水平方向に比べて垂直方向のビームを鋭くして物体の検知エリアを小さくすることが可能となり、超音波振動子は異方向性を持つ指向特性を形成できる。

【０００７】また、請求項２の発明は、請求項１記載の発明において、前記開口部は前記振動面に形成されることを特徴とする。よって、請求項１と同様の効果が得られる。

【０００８】また、請求項３の発明は、請求項１記載の発明のおいて、前記開口部は前記筒状ケースの側面に形成されることを特徴とする。よって、請求項１と同様の効果が得られるとともに、振動面に開口部を設けないため、圧電素子の大きさや位置を制限せずに配置でき、また外観も良くなる。

【０００９】また、請求項４の発明は、請求項１記載の発明において、前記開口部は前記振動面から前記筒状ケースの側面にかけて形成されることを特徴とする。よって、開口部を大きくとることができ、振動面の中心線に対して開口部を形成した形成方向の剛性を弱めることができるので、超音波の送波、受波を行うにあたり、ビームの指向特性の異方向性を向上することができる。

【００１０】また、請求項５の発明は、請求項１から請求項４のいずれかに記載の発明において、前記開口部の前記中心線と平行方向の長さを変更して超音波の指向特性を調整することを特徴とする。よって、超音波の指向特性を変更できる。

【００１１】また、請求項６の発明は、請求項１から請求項４のいずれかに記載の発明において、前記開口部の前記中心線と直交する方向の長さを変更して超音波の指向特性を調整することを特徴とする。よって、超音波の指向特性を変更できる。

【００１２】また、請求項７の発明は、一端面が開口し、他端面が閉塞された筒状ケースの他端面を、その筒状ケース内側略中央部に圧電素子を設けて振動面とし、超音波の送波及び受波を行う超音波振動子において、前記振動面は、その中心を通る中心線を中心に対称となる位置に厚さの薄い薄肉部を有することを特徴とする。よって、振動面の中心線と直交する方向の振動は、その両端部に薄肉部があるため剛性が弱くなって振動しやすくなり、中心線と平行方向の振動に比べて、振動面と直交する方向に平面振動する部分が大きくなるように振動する。その結果、水平方向に比べて垂直方向のビームを鋭くして物体の検知エリアを小さくすることが可能となり、超音波振動子は異方向性を持つ指向特性を形成できる。

【００１３】請求項８の発明は、請求項７記載の発明において、前記振動面の前記筒状ケース内側の形状は、前記振動面の中心線に対して前記薄肉部が形成されている形成方向に延びる互いに略平行な２つの直線を有する形状であることを特徴とする。よって、中心線と水平方向の超音波のビームを太くすることができ、超音波のビームの指向特性の異方向性を向上することができる。

【００１４】また、請求項９の発明は、請求項８記載の発明において、前記薄肉部の前記中心線と平行方向の長さが、前記対称となる位置に設けられた各薄肉部間にある前記振動面の前記平行方向の長さ以上であることを特徴とする。よって、中心線と垂直方向の超音波のビームを太くすることができ、超音波のビームの指向特性の異方向性を向上することができる。

【００１５】また、請求項１０の発明は、請求項７記載の発明において、前記薄肉部は、その深さ方向に向かって幅が狭くなる形状であることを特徴とする。よって、

5

筒状ケースの製造において、塑性加工にて容易に精度良く薄肉部を形成することができる。

【００１６】また、請求項１１の発明は、請求項７から請求項１０のいずれかに記載の発明において、前記薄肉部は、前記振動面の前記筒状ケースの内側に設けられていることを特徴とする。よって、筒状ケースの外観が良くなる。

【００１７】また、請求項１２の発明は、請求項７から請求項１０のいずれかに記載の発明において、前記薄肉部は、前記振動面の前記筒状ケースの外側に設けられていることを特徴とする。よって、筒状ケースの内部に充填材にて充填した後においても、薄肉部の長さ、深さ、数により、振動面の振動状態を任意に調整できる。

【００１８】また、請求項１３の発明は、請求項７から請求項１０のいずれかに記載の発明において、前記薄肉部は、前記振動面の前記筒状ケースの内側と内側の両方に設けられていることを特徴とする。よって、内側に設けられる薄肉部により振動面の目標となる振動状態を形成し、外側の薄肉部により超音波振動子の製造後の振動状態の微調整を行うことができ、外側の薄肉部は微調整のために形成されるため、その大きさを小さくすることができ、外観が良くなる。

【００１９】また、請求項１４の発明は、請求項７記載の発明において、前記振動面の前記筒状ケース外側の形状は、前記振動面の中心線に対して前記薄肉部が形成されている形成方向に延びる互いに略平行な２つの直線を有する形状であることを特徴とする。よって、前記筒状ケースの中心線と平行方向の幅が狭くなり、超音波振動子を車両のバンパーに取り付ける際に、筒状ケースを保持する保持ゴムの厚みを大きくできるため、バンパー取り付け部から振動面への影響を軽減できる。また、筒状ケースの外観より薄肉部の形成方向を知ることができる。

【００２０】また、請求項１５の発明は、請求項１から請求項１４のいずれかに記載の発明において、前記筒状ケースを鍛造製法により製造することを特徴とする。よって、筒状ケースの製造コストを削減することができる。

【００２１】また、請求項１６の発明は、請求項１から請求項１５のいずれかに記載の発明において、前記筒状ケース側面の外壁の肉厚が前記開口した一端面側の方が前記振動面側より厚くなるように、前記筒状ケースの側面に段差部が設けられていることを特徴とする。よって、超音波振動子を車両のバンパーに取り付けたときの外観を小さくできるとともに、開口した一端面側の肉厚が厚くなった外壁により筒状ケースの剛性を強め、振動面をより大きく振動させることができる。

【００２２】また、請求項１７の発明は、請求項１から請求項１６のいずれかに記載の発明において、前記段差部はテーパ形状であることを特徴とする。よって、筒状

6

ケースの鍛造加工による製造が可能となり、製造コストを削減できる。

【００２３】

【発明の実施の形態】（実施形態１）図１は本発明の超音波振動子の実施形態１を示す図であり、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。略円筒状の筒状ケース１は、その一端面１ｃが開口しており、他端面は閉塞され筒状ケース１内側の略中央部に圧電素子２を貼り付けて配置し、振動面１ａとしている。筒状ケース１と圧電素子２のそれぞれには外部回路より信号が入出力されるリード線４が接続され、入力された信号をもとに圧電素子２を振動させて、振動面１ａより上記一端面１ｂと反対側に超音波を送波するとともに、送波した超音波が物体に反射した反射波を振動面１ａより受波し、圧電素子２を介して電気信号をリード線４より上記外部回路に出力する。すなわち、筒状ケース１、圧電素子２、リード線４により超音波振動子が構成される。

【００２４】筒状ケース１の軸と直交する面の一つである振動面１ａの面上には、圧電素子２の設けられた位置の外側であり、振動面１ａの中心Ｐを通る中心線Ｐ１を中心に対称となる位置に、それぞれ１つずつ中心線Ｐ１と平行方向に長さＡ１を有し、長さＡ１方向と直交する方向に長さＢ１を有する円弧状の開口部３，３が設けられている。この開口部３，３はゴムにて封止される。

【００２５】この超音波振動子の中心線Ｐ１と直交する方向（以後、垂直方向と呼ぶ）の振動は、その両端部に開口部３，３があるため剛性が弱くなって振動しやすくなり、中心線Ｐ１と平行方向（以後、水平方向とよぶ）の振動に比べて、振動面１ａと直交する方向に平面振動する部分が大きくなるように振動する。その結果、水平方向に比べて垂直方向のビームを鋭くして物体の検知エリアを小さくすることが可能となり、超音波振動子は異方向性を持つ指向特性を形成できる。

【００２６】また、開口部３の中心線Ｐ１と平行方向の長さＡ１、あるいは中心線Ｐ１と直交する方向の長さＢ１を変更することにより、振動面１ａの垂直方向の剛性が変化するため、振動面１ａの垂直方向の振動状態が変わる。よって、上記長さＡ１、あるいは長さＢ１を変更することで、振動面１ａの垂直方向のビームの鋭さを自由に設定可能となり、超音波の指向特性を調整できる。

（実施形態２）図２は本発明の超音波振動子の実施形態２を示す図であり、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。図２において図１と異なる点は、図１では振動面１ａ上に、中心線Ｐ１を中心として対称となる位置にそれぞれ開口部３，３が設けられていたのに対して、図２では筒状ケース１の側面１ｃの振動面１ａと接する位置に、それぞれ１つずつ中心線Ｐ１と平行方向に長さＡ２を有し、長さＡ２と直交する方向に長さＢ２を有する略長方形状の開口部３ａ，３ａが設

7

けられている点である。ここで、中心線Ｐ１は筒状ケース１の側面の開口部３ａ，３ａを有する面、すなわち筒状ケース１の軸と直交する面を通る中心線である。

【００２７】振動面１ａの垂直方向の振動は、開口部３ａが設けられているため剛性が弱くなって振動しやすくなり、水平方向の振動に比べて、振動面１ａと直交する方向に平面振動する部分が大きくなるよう振動する。その結果、水平方向に比べて垂直方向のビームを鋭くして物体の検知エリアを小さくすることが可能となり、超音波振動子は異方向性を持つ指向特性を形成できる。

【００２８】また、図１と同様に開口部３ａの中心線Ｐ１と平行方向の長さＡ２、あるいは中心線Ｐ１と直交する方向の長さＢ２を変更することで、振動面１ａの垂直方向のビームの鋭さを自由に設定可能となり、超音波の指向特性を調整できる。

【００２９】そしてまた、振動面１ａに開口部がないので、圧電素子２の大きさや貼りつけ位置を制限せずに配置でき、また外観も良くなる。

（実施形態３）図３は本発明の超音波振動子の実施形態３を示す図であり、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。図３において図１と異なる点は、図１では振動面１ａ上に、中心線Ｐ１を中心として対称となる位置にそれぞれ開口部３，３が設けられていたのに対して、図３では振動面１ａの端部からそれに連接する側面１ｂにかけて開口した開口部３ｂが、中心線Ｐ１を中心に対称となる位置に、それぞれ１つずつ設けられている点である。そして、超音波振動子全体を保持ゴム９で覆い、車両のバンパーに嵌合している。この保持ゴム９により開口部３ｂも封止しており、部品点数の削減となる。

【００３０】このように、振動面１ａから側面１ｂにかけて開口部３ｂを設けたため、開口部をより大きくとることができ、振動面１ａの垂直方向の剛性を弱めることができ、水平方向に比べて垂直方向は振動面１ａと直交する方向に平面振動する部分が大きくなる振動をする。その結果、水平方向に比べて垂直方向のビームを鋭くして物体の検知エリアを小さくすることが可能となり、超音波振動子は異方向性を持つ指向特性を形成できる。

【００３１】また、開口部３ｂの中心線Ｐ１方向と平行方向の長さＡ３、あるいは中心線Ｐ１と直交する方向の長さＢ３を変更することにより、振動面１ａの垂直方向の剛性が変化するため、振動面１ａの垂直方向の振動状態が変わる。よって、振動面１ａの垂直方向のビームの鋭さを自由に設定可能となり、超音波の指向特性を調整できる。

（実施形態４）図４は本発明の超音波振動子の実施形態４を示す図であり、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。図４において図１と異なる点は、図１では振動面１ａ上に、中心線Ｐ１を中心として対称となる位置にそれぞれ１つずつ開口部３，３が設

8

けられていたのに対して、図４では振動面１ａの筒状ケース１の内側に、中心線Ｐ１を中心として対称となる位置にそれぞれ１つずつ振動面１ａの肉厚より薄い薄肉部５，５が設けられている点である。この薄肉部５は、圧電素子２が配置されている位置の外側に設けられており、中心線Ｐ１と平行方向に一定の幅と深さを有する円弧形状である。

【００３２】そのため、振動面１ａの振動は、水平方向は単純なたわみ振動であるが、垂直方向は圧電素子２を貼り付けている部分でたわみ振動が生じ、その外側に設けられている薄肉部５のために振動しやすくなり、水平方向に比べて振動面１ａと直交する方向に平面振動する部分が大きくなる。その結果、水平方向に比べて垂直方向のビームを鋭くして物体の検知エリアを小さくすることが可能となり、超音波振動子は異方向性を持つ指向特性を形成できる。

（実施形態５）図５は本発明の超音波振動子の実施形態５を示す図であり、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。図５において図４と異なる点は、図４では振動面１ａの筒状ケース１内側の形状が略円形状であり、その円形状の外周よりやや中心Ｐ側に薄肉部５が配置されているのに対し、図５では振動面１ａの筒状ケース１内側の形状が、中心線Ｐ１を挟んでそれぞれ水平方向に円弧状の曲線７ａ，７ｂが設けられ、その曲線７ａ，７ｂのそれぞれの端部が結ばれて、中心線Ｐ１と略直交し、互いに略平行の直線６ａ，６ｂとなる形状となっている点である。そして、中心線Ｐ１を中心に対称となる位置であり、上記それぞれの円弧状の曲線７ａ，７ｂと接する位置に、一定の幅を有し中心線Ｐ１方向に円弧状である薄肉部５ａ，５ａが設けられている。

【００３３】このため、振動面１ａの筒状ケース１内側の形状が略円形状である場合に比べて、中心線Ｐ１方向の幅が狭くなる。よって、振動面１ａの水平方向が垂直方向と比べて狭い範囲で振動し、水平方向のビームをより太くすることができ、物体の検知エリアを小さくすることが可能となり、超音波振動子は異方向性を持つ指向特性を形成できる。

【００３４】このとき、図６（ａ）に示すように、薄肉部が一定の幅を有する円弧状でなく、中心側が中心線Ｐ１に平行な直線である形状の薄肉部１１ａ、図６（ｂ）に示すように、外側が中心線Ｐ１に平行な直線である形状の薄肉部１１ｂ、中心側、外側の両方が中心線Ｐ１に平行な直線である形状の薄肉部１１ｃであってもよい。

【００３５】また、図７（ａ）（ｂ）（ｃ）（ｄ）に示すように、薄肉部１２ａ，１２ｂ，１２ｃ，１２ｄの水平方向の長さＳ１が振動面１ａの筒状ケース１内側における水平方向の幅Ｓ２より大きくなるように形成すると、薄肉部１２ａ，１２ｂ，１２ｃ，１２ｄの剛性をより弱めることができ、水平方向に比べて垂直方向のビー

ムをより鋭くすることができる。

（実施形態６）図８は本発明の超音波振動子の実施形態６を示す図であり、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。図８において図４と異なる点は、図４では振動面１ａの筒状ケース１内側に、中心線Ｐ１を中心として対称となる位置にそれぞれ１つずつ一定の幅と深さを有する薄肉部５，５が設けられていたのに対して、図８では振動面１ａの筒状ケース１の内側に、中心線Ｐ１を中心として対称となる位置にそれぞれ２つずつ、深くなるにつれて幅が小さくなる断面が略Ｖ字形状であり、背面からみた形状が円弧状である薄肉部５ｂが設けられている点である。また、薄肉部５ｂは、深くなるにつれて幅が小さくなる断面が略円弧形状であってもよい。

【００３６】このような断面が略Ｖ字形状、略円弧形状の薄肉部は塑性加工で容易に精度よく形成できる。また、この薄肉部５ｂの長さ、深さ、数を変更することで、振動面１ａの振動状態を調整できる。

（実施形態７）図９は本発明の超音波振動子の実施形態７を示す図であり、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。図９において図４と異なる点は、図４では振動面１ａの筒状ケース１内側に、中心線Ｐ１を中心として対称となる位置にそれぞれ１つずつ一定の幅と深さを有する薄肉部５，５が設けられていたのに対して、図９では振動面１ａの筒状ケース１の外側に、中心線Ｐ１を中心として対称となる位置にそれぞれ２つずつ、一定の幅と深さを有し、正面からみた形状が円弧状である薄肉部５ｃが設けられている点である。

【００３７】このように、薄肉部５ｃが振動面１ａの筒状ケース１の外側に設けられるため、筒状ケース１の内部を充填材にて充填した後でも、薄肉部５ｃの長さ、深さ、数を変更することによって、振動面１ａの振動状態を調整することができ、超音波振動子の製造後の微調整が可能となる。

（実施形態８）図１０は本発明の超音波振動子の実施形態８を示す図であり、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。図１０において図４と異なる点は、図４では振動面１ａの筒状ケース１内側に、中心線Ｐ１を中心として対称となる位置にそれぞれ１つずつ一定の幅と深さを有する薄肉部５，５が設けられていたのに対して、図１０ではさらに振動面１ａの筒状ケース１の外側にも、中心線Ｐ１を中心として対称となる位置にそれぞれ１つずつ、一定の幅と深さを有し、正面からみた形状が円弧状である薄肉部５ｄが設けられている点である。

【００３８】ここで、筒状ケース１の内側の薄肉部５の形成により、振動面１ａの目標とする振動状態を作り、筒状ケース１の外側の薄肉部５ｄを用いて超音波振動子を製造した後の振動モードの微調整を行うようにする。

【００３９】これにより、超音波振動子の製造後の振動

状態の微調整が可能となるとともに、筒状ケース１の外側に設けた薄肉部は小さくすることができ、外観が良くなる。

【００４０】（実施形態９）図１１は本発明の超音波振動子の実施形態９を示す図であり、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。図１１は図５に示した超音波振動子の振動面１ａの外面形状が、中心線Ｐ１を挟んでそれぞれ垂直方向に円弧状の曲線１５ａ，１５ｂが設けられている点は図５と同様であり、その曲線１５ａ，１５ｂのそれぞれの端部が結ばれて、中心線Ｐ１と略直交した方向、つまり中心線Ｐ１に対して薄肉部５ａが形成された方向に延びる互いに略平行の直線１４ａ，１４ｂが形成される形状となっている点が異なる。すなわち、図１１の超音波振動子では図５に比べてその外面形状は、水平方向の幅が狭くなっている。この超音波振動子は、周囲が保持ゴム９で覆われバンパーに嵌合される。

【００４１】上記各実施形態で説明した薄肉部を設ける構成では、筒状ケース１の側面振動は水平方向が大きくなる。そこで、図１１に示すように水平方向の幅が狭くなる外面形状とすることで、保持ゴム９の水平方向の厚みを厚くすることが可能となり、超音波振動子を保持ゴム９で保持してバンパーに取り付けたとき、振動面１ａへの影響を軽減することができる。また、振動面１ａの外面形状が略円形でなく、中心線Ｐ１に対する薄肉部５ａの形成方向に延びる略平行の２直線を有する構成であるため、外観よりバンパーなどへの取り付け方向が分かるようになる。

（実施形態１０）図１２は本発明の超音波振動子の実施形態１０を示す側面断面図である。図５に示した筒状ケース１の側面１ｃの外壁に、図１２では開口した一端面１ｂ側の方の外壁１６が、振動面１ａ側の方の外壁１９より幅が太くなるように、段差部１７が形成されている点が異なる。図１２では、このように構成された超音波振動子を保持ゴム９で保持して、段差部１７がバンパー１０の内側に係止するようにバンパー１０に取り付けている。

【００４２】この幅が太くなるように構成された外壁１６により、筒状ケース１の剛性を強めて振動面１ａをより大きく振動させることができる。このとき、バンパー１０に取り付けた外観を小さくできる。

【００４３】図１３は、図１２に示した段差部１７にテーパ１８を持たせた例を示している。これにより、段差部１７を鍛造加工にて製造することが可能となり、製造コストを削減できる。図８で示したように塑性加工にて薄肉部５ｂを形成して筒状ケース１を製造するものにおいても、段差部１７の加工と同様に鍛造加工にて製造して製造コストを削減できる。

【００４４】

【発明の効果】上記したように、請求項１の発明は、一

端面が開口し、他端面が閉塞された筒状ケースの他端面を、その筒状ケース内側略中央部に圧電素子を設けて振動面とし、超音波の送波及び受波を行う超音波振動子において、前記筒状ケースは、その軸と直交する面の各中心を通る中心線を中心として対称となる位置に開口部を有するため、振動面の中心線と直交する方向の振動は、その両端部に開口部があるため剛性が弱くなって振動しやすくなり、中心線と平行方向の振動に比べて、振動面と直交する方向に平面振動する部分が大きくなるように振動する。その結果、水平方向に比べて垂直方向のビームを鋭くして物体の検知エリアを小さくすることが可能となり、超音波振動子は異方向性を持つ指向特性を形成できる。

【００４５】また、請求項２の発明は、請求項１記載の発明において、前記開口部は前記振動面に形成されるため、請求項１と同様の効果が得られる。

【００４６】また、請求項３の発明は、請求項１記載の発明のおいて、前記開口部は前記筒状ケースの側面に形成されるため、請求項１と同様の効果が得られるとともに、振動面に開口部を設けないため、圧電素子の大きさや位置を制限せずに配置でき、また外観も良くなる。

【００４７】また、請求項４の発明は、請求項１記載の発明において、前記開口部は前記振動面から前記筒状ケースの側面にかけて形成されるため、開口部を大きくとることができ、振動面の中心線に対して開口部を形成した形成方向の剛性を弱めることができるので、超音波の送波、受波を行うにあたり、ビームの指向特性の異方向性を向上することができる。

【００４８】また、請求項５の発明は、請求項１から請求項４のいずれかに記載の発明において、前記開口部の前記中心線と平行方向の長さを変更して超音波の指向特性を調整するため、超音波の指向特性を変更できる。

【００４９】また、請求項６の発明は、請求項１から請求項４のいずれかに記載の発明において、前記開口部の前記中心線と直交する方向の長さを変更して超音波の指向特性を調整するため、超音波の指向特性を変更できる。

【００５０】また、請求項７の発明は、一端面が開口し、他端面が閉塞された筒状ケースの他端面を、その筒状ケース内側略中央部に圧電素子を設けて振動面とし、超音波の送波及び受波を行う超音波振動子において、前記振動面は、その中心を通る中心線を中心に対称となる位置に厚さの薄い薄肉部を有するため、振動面の中心線と直交する方向の振動は、その両端部に薄肉部があるため剛性が弱くなって振動しやすくなり、中心線と平行方向の振動に比べて、振動面と直交する方向に平面振動する部分が大きくなるように振動する。その結果、水平方向に比べて垂直方向のビームを鋭くして物体の検知エリアを小さくすることが可能となり、超音波振動子は異方向性を持つ指向特性を形成できる。

【００５１】請求項８の発明は、請求項７記載の発明において、前記振動面の前記筒状ケース内側の形状は、前記振動面の中心線に対して前記薄肉部が形成されている形成方向に延びる互いに略平行な２つの直線を有する形状であるため、中心線と水平方向の超音波のビームを太くすることができ、超音波のビームの指向特性の異方向性を向上することができる。

【００５２】また、請求項９の発明は、請求項８記載の発明において、前記薄肉部の前記中心線と平行方向の長さが、前記対称となる位置に設けられた各薄肉部間にある前記振動面の前記平行方向の長さ以上であるため、中心線と垂直方向の超音波のビームを太くすることができ、超音波のビームの指向特性の異方向性を向上することができる。

【００５３】また、請求項１０の発明は、請求項７記載の発明において、前記薄肉部は、その深さ方向に向かって幅が狭くなる形状であるため、筒状ケースの製造において、塑性加工にて容易に精度良く薄肉部を形成することができる。

【００５４】また、請求項１１の発明は、請求項７から請求項１０のいずれかに記載の発明において、前記薄肉部は、前記振動面の前記筒状ケースの内側に設けられているため、筒状ケースの外観が良くなる。

【００５５】また、請求項１２の発明は、請求項７から請求項１０のいずれかに記載の発明において、前記薄肉部は、前記振動面の前記筒状ケースの外側に設けられているため、筒状ケースの内部に充填材にて充填した後においても、薄肉部の長さ、深さ、数により、振動面の振動状態を任意に調整できる。

【００５６】また、請求項１３の発明は、請求項７から請求項１０のいずれかに記載の発明において、前記薄肉部は、前記振動面の前記筒状ケースの内側と内側の両方に設けられているため、内側に設けられる薄肉部により振動面の目標となる振動状態を形成し、外側の薄肉部により超音波振動子の製造後の振動状態の微調整を行うことができ、外側の薄肉部は微調整のために形成されるため、その大きさを小さくすることができ、外観が良くなる。

【００５７】また、請求項１４の発明は、請求項７記載の発明において、前記振動面の前記筒状ケース外側の形状は、前記振動面の中心線に対して前記薄肉部が形成されている形成方向に延びる互いに略平行な２つの直線を有する形状であるため、前記筒状ケースの中心線と平行方向の幅が狭くなり、超音波振動子を車両のバンパーに取り付ける際に、筒状ケースを保持する保持ゴムの厚みを大きくできるため、バンパー取り付け部から振動面への影響を軽減できる。また、筒状ケースの外観より薄肉部の形成方向を知ることができる。

【００５８】また、請求項１５の発明は、請求項１から請求項１４のいずれかに記載の発明において、前記筒状

13

ケースを鍛造製法により製造するため、筒状ケースの製造コストを削減することができる。

【００５９】また、請求項１６の発明は、請求項１から請求項１５のいずれかに記載の発明において、前記筒状ケース側面の外壁の肉厚が前記開口した一端面側の方が前記振動面側より厚くなるように、前記筒状ケースの側面に段差部が設けられているため、超音波振動子を車両のバンパーに取り付けたときの外観を小さくできるとともに、開口した一端面側の肉厚が厚くなった外壁により筒状ケースの剛性を強め、振動面をより大きく振動させることができる。

【００６０】また、請求項１７の発明は、請求項１から請求項１６のいずれかに記載の発明において、前記段差部はテーパ形状であるため、筒状ケースの鍛造加工による製造が可能となり、製造コストを削減できる。

【図面の簡単な説明】

【図１】本発明の実施形態１に対応する超音波振動子の構造を示す図であって、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。

【図２】本発明の実施形態２に対応する超音波振動子の構造を示す図であって、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。

【図３】本発明の実施形態３に対応する超音波振動子の構造を示す図であって、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。

【図４】本発明の実施形態４に対応する超音波振動子の構造を示す図であって、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。

【図５】本発明の実施形態５に対応する超音波振動子の構造を示す図であって、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。

【図６】同上の超音波振動子の他の構造を示す図であって、（ａ）（ｂ）（ｃ）はいずれも背面図である。

【図７】同上の超音波振動子の更に他の構造を示す図であって、（ａ）（ｂ）（ｃ）（ｄ）はいずれも背面図である。

14

【図８】本発明の実施形態６に対応する超音波振動子の構造を示す図であって、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。

【図９】本発明の実施形態７に対応する超音波振動子の構造を示す図であって、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。

【図１０】本発明の実施形態８に対応する超音波振動子の構造を示す図であって、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。

【図１１】本発明の実施形態９に対応する超音波振動子の構造を示す図であって、（ａ）は正面図、（ｂ）は側面断面図、（ｃ）は背面図である。

【図１２】本発明の実施形態１０に対応する超音波振動子を車両のバンパーに取り付けた状態を示す側面断面図である。

【図１３】同上の超音波振動子の他の構造を示す側面断面図である。

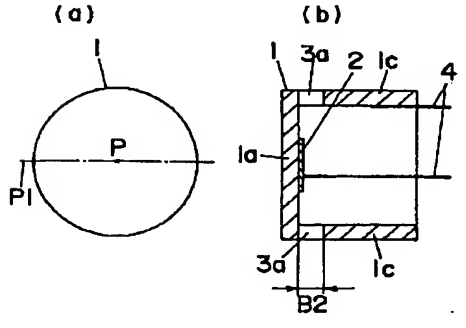
【図１４】従来の超音波振動子の構造を示す図であって、（ａ）は正面図、（ｂ）は側面断面図である。

【図１５】従来の超音波振動子にホーンを取り付けた状態を示す図であって、（ａ）は正面図、（ｂ）は側面断面図である。

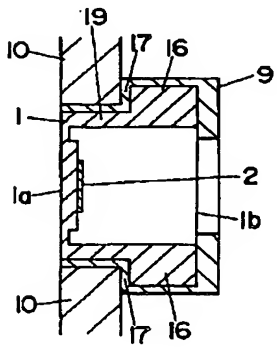
【符号の説明】

１　筒状ケース
１ａ　振動面
１ｂ　一端面
２　圧電素子
３　開口部
４　リード線
Ｐ１　中心線
Ｐ　中心

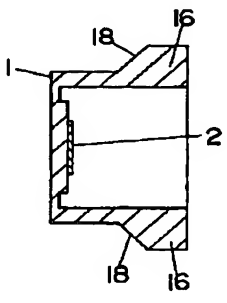
【図２】



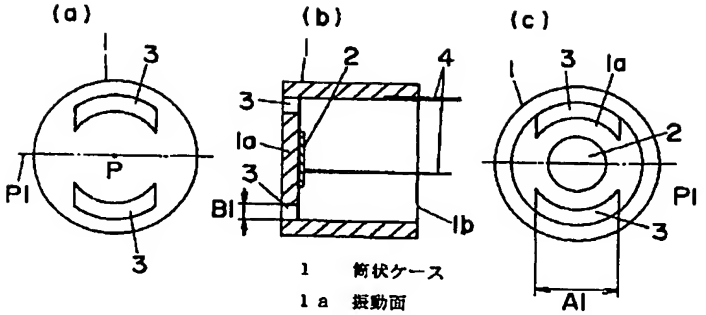
【図１２】



【図１３】

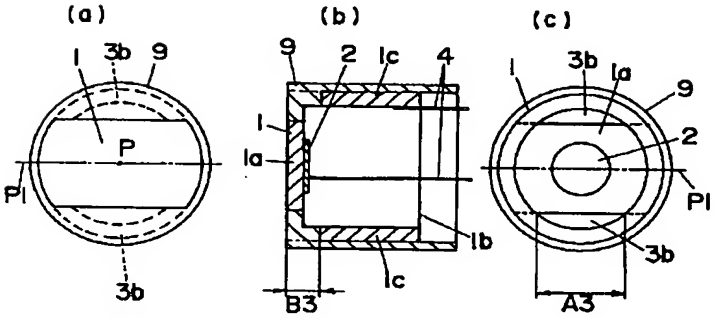


【図１】

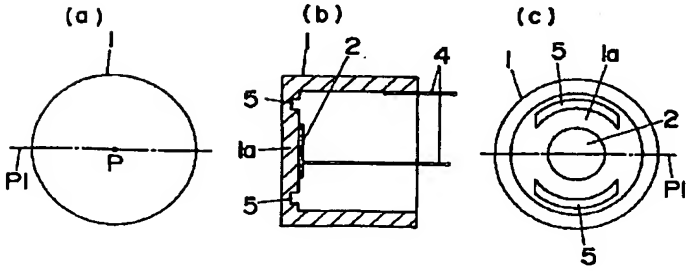


1　筒状ケース
1a　振動面
1b　一端面
2　圧電素子
3　両口部
4　リード線
P1　中心線
P　中心

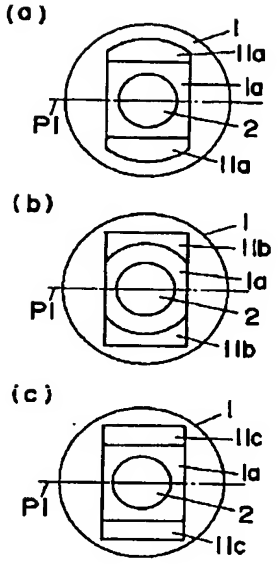
【図３】



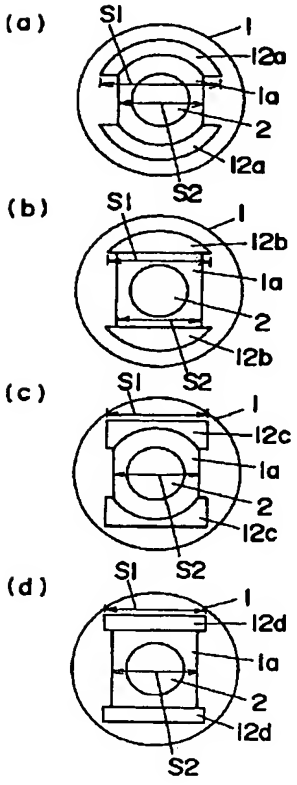
【図４】



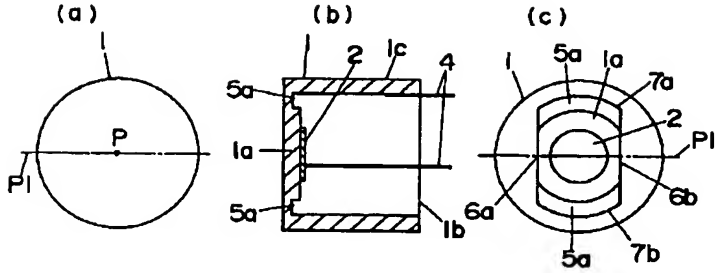
【図６】



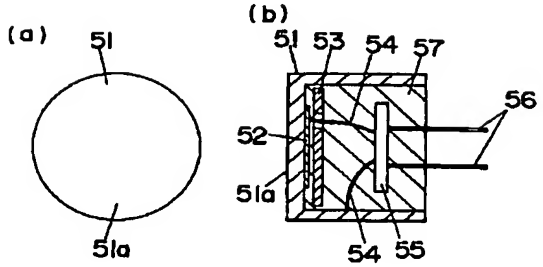
【図７】



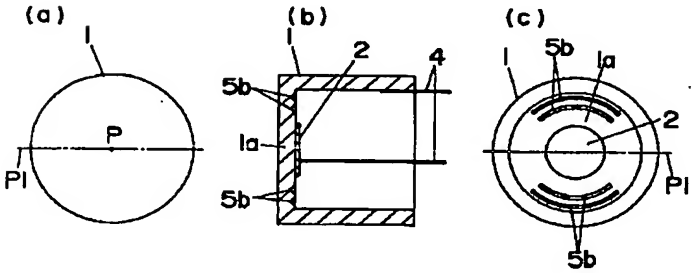
【図５】



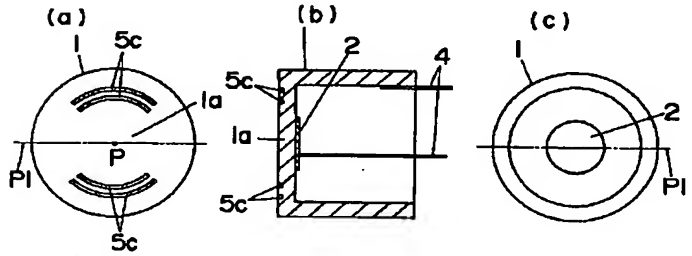
【図１４】



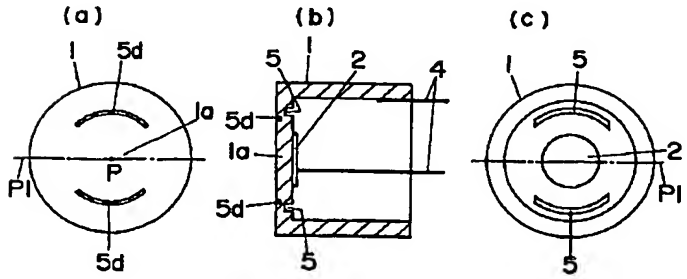
【図８】



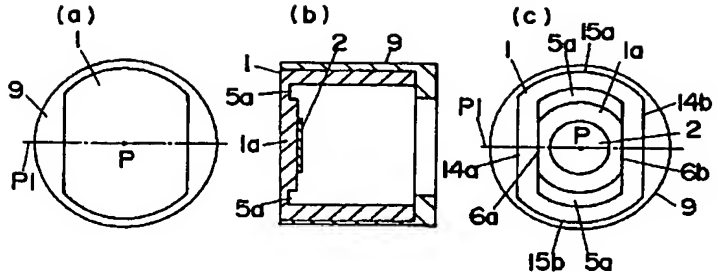
【図９】



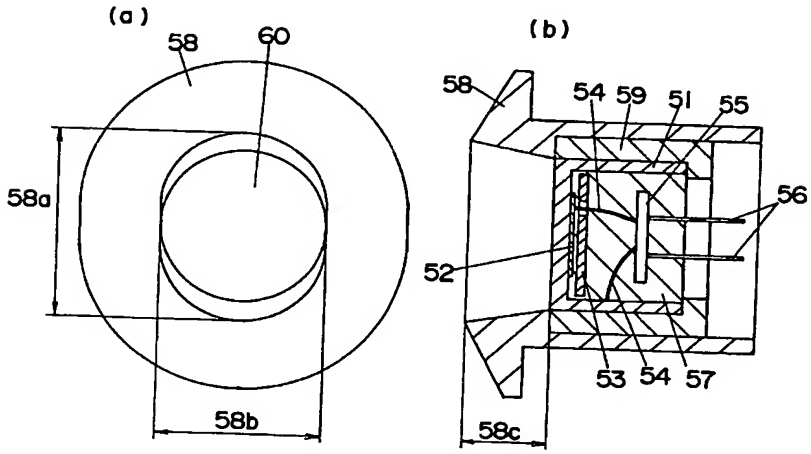
【図１０】



【図１１】



【図１５】



フロントページの続き

(72)発明者　高木　俊昌
大阪府門真市大字門真1048番地松下電工株式会社内
(72)発明者　宇野　真武
大阪府門真市大字門真1048番地松下電工株式会社内
(72)発明者　小野　健
大阪府門真市大字門真1048番地松下電工株式会社内
(72)発明者　橋本　裕介
大阪府門真市大字門真1048番地松下電工株式会社内
(72)発明者　大谷　隆児
大阪府門真市大字門真1048番地松下電工株式会社内
(72)発明者　足立　将彦
大阪府門真市大字門真1048番地松下電工株式会社内

Ｆターム(参考)　5D019 AA01 EE01 EE04 FF01
5J083 AA02 AB12 AC17 AE10 BC01
CA15 CA22 CA35 CB01 CB07